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CANADIAN PATENT

INFLATABLE BOLSTER

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No. OF CLAIMS 12

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This invention provides an inflatable structure, impervious to fluids and built up of superposed plies of rubberized fabric or the like, which can be readily fabricated in large diameters, of 30 inches or more, and in long lengths.

The invention provides a method of manufacturing such an inflatable structure which comprises curing under heat and pressure in a conveyor belt or similar press successive lengths of an assembly constituted by a plurality of superposed plies of rubberized fabric or the like wrapped around one another with staggered joints, the assembly including inside the innermost ply a material which will prevent the opposed surfaces of this ply from bonding together.

The resulting product is flat and has the external appearance of a conveyor belt, but it has a passage way extending throughout its length. By clamping its ends and fitting an entry valve, the "belt" can be inflated to form a bolster, filled with liquid as a tank, or by making suitable coupling connections to the ends instead of clamping, the structure can be employed as a hose.

In some cases it is convenient to provide the assembly with a tube of rubber, polyvinyl chloride or other suitable thermoplastic material devoid of fabric as the innermost 'ply', in which case the adhesion-preventing material may be provided as a coating on the interior of this tube. The assembly may also include an outer abrasion resisting cover, which may be of the same material as the inner tube.

The constituent plies are preferably of woven fabric containing a synthetic yarn, such for example as nylon or terylene (Registered Trade Mark), rubberized with natural or synthetic rubber. The fabric plies may, however, be impregnated by other materials which will cure and bond together in the press, such for example as polyvinyl chloride, a mixture of polyvinyl chloride and nitrile rubber and other suitable thermoplastic materials. The plies need not, however, necessarily be of woven fabric. Thus they may, in suitable cases consist of films of nylon or terylene,

of latex-impregnated non-woven fabric or of paper impregnated with a thermoplastic material, or a resin.

Inflatable 'belts' made as described above may be utilized as inflatable bolsters, e.g. 30 inches in diameter and 120 feet in length, for use in supporting the roof in a colliery, as pillow tanks for the transport of liquid in bulk on road vehicles, as floating booms for use in harbours to prevent the spread of floating oil from oil loading installations and as hoses manufactured in long lengths for emergency supplies of water or fuel oil. They may also be used, when inflated, as dockside fenders, weighted at one end, floating in an upright position against the dock wall and anchored thereto by chains.

If desired the hose may be provided with a double or multiple internal passage way by laying an internal ply or plies of rubberised fabric across the interior of the innermost folded ply with adhesion-preventing material between the opposite surfaces of the internal ply or plies and the surfaces of the innermost ply. Each innermost ply will then form when the hose is inflated an internal longitudinal bulkhead which will operate to prevent surge of contained liquid when the hose is used as a pillow tank, or to provide separated passage ways for the containment and conveyance of different fluids when used as a hose or boom.

In the case of a pillow tank the bulkheads are lightly perforated to equalise distribution of liquid into the various compartments. In a hose of multiple bore they are not perforated.

The process of manufacture is continuous and there is no restriction, except for transport difficulties, on the length of hose which can be produced in one piece. In this respect the hose is produced exactly as a conveyor belt is made, in that a built up carcase is assembled in a flat state and fed into a press and vulcanized length by length successively with overlaps, and coiled up again after vulcanization.

The hose can accordingly be manufactured in lengths of up to

1000 ft. and its diameter is restricted only by the width of the press available. Since the hose, although of larger diameter, is produced in a flat state, it is, like a fire hose, easy to coil. In fact, it coils exactly as if it were an ordinary conveyor belt. The resulting coil is stable and compact and can easily be transported and handled. The hose will run off the coil freely in the flat condition and only becomes round in section when internal pressure is applied. On emptying, or upon deflation, the hose returns to the flat state and can be readily coiled again. Other rubber hoses of large diameter which have been built on mandrels are intrinsically round and do not coil satisfactorily so that they can only be handled in extremely limited lengths.

The adhesion-preventing material may be constituted by a powdered, liquid or gel-like material such for example as ground mica, whiting, talc, starch, clay, an emulsion of wax with or without a silicone, sulphonated castor oil, a mixture of sulphonated fatty acid, a polyethylene glycol, glycerine, or methyl cellulose or polyvinyl alcohol in gel or paste form. Methyl cellulose and polyvinyl alcohol leave a film within the cured assembly which is soluble in water and can subsequently be washed out of the structure.

Alternatively, the adhesion-preventing material may be in sheet form and constituted, for example, by a sheet of metal, vulcanized rubber, cured rubber hydrochloride, or polyvinyl chloride or other vinyl polymer. In this case the sheet also acts as a former. When such a former is used, it is in most cases desirable to provide a parting agent between the former and the innermost ply in order to prevent the innermost ply from sticking to the former. Preferably the parting agent is provided as a coating on the internal surfaces of the innermost ply in order to prevent them from sticking together during handling and advance of the superposed plies to the press. Preparations of chalk, talc or zinc stearate powder or combinations of these would normally be used as surface coatings for the rubber innermost ply. It is also possible to coat a metal former with wax, or a silicone grease release agent, or to coat the former with a heat resisting inert varnish layer to prevent adhesion of the rubber

to it during vulcanization. The inert varnish may consist of a silicone resin, and preparations of poly-tetra-fluor-ethylene may also be employed. If the former is of vulcanized natural or synthetic rubber the presence of a coating of chalk or talc on the surface of the uncured inner ply will be sufficient to prevent adhesion. In the case of the former being made of a temperature resistant, inert material such as P.T.F.E., no parting agent will be necessary.

The former, when of rigid material, may have rounded edges and this serves to eliminate the production of sharp creases at the edges of the innermost ply when the assembly is cured in the press. The former may conveniently be a metal plate having a thickness of the order of 1/8".

When producing an inflatable structure of considerable length, the former will be short and withdrawn from each pressed length into the next length to be pressed. In the case, however, of shorter structures intended for use as pillow tanks or spill booms, the former may extend for the full length of the assembly and be withdrawn after assembly. To facilitate withdrawal, the former may be split longitudinally. When, the former may be dis-engaged from close contact with the internal edges of the assembly by causing the edge of one half to ride over the other half, whereupon it may easily be withdrawn.

When the former is of rubber or other elastic material it may contain embedded longitudinal yarns so that it may expand sideways under pressure to ensure moulding of the inner edges of the assemblage and nevertheless be capable of being withdrawn lengthwise over a considerable length without breaking or stretching unduly.

The invention will now be further explained with reference to the accompanying diagrammatic drawings, in which:-

Fig.1 is a transverse section through an inflatable structure made in accordance with the invention,

Fig.2 is a diagram illustrating the fabrication of the structure shown in Fig.1,

Figs.3 and 4 are sectional views illustrating alternative forms of press for use in accordance with the invention,

Fig.5 is a section through an internal ply for use in making a hose with a double internal passage way,

Fig.6 shows the resultant hose after curing,

Fig.7 shows the resultant hose when expanded,

Figs.8-10 are sectional views illustrating alternative forms of end closure,

Fig.11 shows an appropriate form of former,

Fig.12 illustrates the moulding of an assemblage round a former,

Figs.13A, B and C illustrate successive stages in the fabrication of a rubber former with embedded textile yarns,

Fig.14 illustrates the manufacture of a hose with reinforcing rubber rods and

Fig.15 illustrates a hose with reinforcing fabric strips at its edges.

The hose shown in Fig.1, which is suitable for use as an inflatable bolster, consists of an inner tube 20 of rubber, a series of surrounding plies 21 of rubberized fabric having longitudinally staggered joints 22 and an external abrasion resisting cover 23 of rubber. As indicated in Fig.2, the inner tube 20 of rubber, containing the adhesion preventing ingredient and either formed as a tube or constituted by a strip of rubber folded into tubular form with an overlap joint, is fed forward to form the innermost layer of a carcase as it travels forward. A strip 21 of rubberized cloth is drawn from a roll 24 of the cloth and folded around it to form a ply having an overlap joint 22 which is staggered in relation to the joint (when present) on the tube. This procedure is repeated to apply in succession further cloth plies, using cloth of progressively increasing width and staggering the joints in successive plies. The outer covering of rubber is then applied. The carcase is then vulcanized, length by length, between the top and bottom platens 25 (Fig.3) of a belting press, edge

moulding bars 26 being provided if desired. These need not necessarily contact the outer edges of the hose as illustrated but can be used simply as spacers between the platens 25. When the inflatable structure is intended for use as a round hose, edge moulding bars 26 with concave inner faces may be use in the press to ensure that the edges of the moulded structure will be convex and that it will inflate to a circular hose of uniform wall thickness.

If the hose is required to have reinforced edges and an outstanding fin 30 at each edge additional plies 29 of rubberiz fabric (Fig.4) are superimposed upon the edges of the carcase beneath the rubber covering, and the press will include top and bottom edge moulding bars 27 in addition to the platens 25 and the moulding bars 26.

If the length of cloth in a roll is insufficient to make-u; a full length of hose, each ply may be made up of successive lengths of cloth joined end to end with an overlap bias joint at 45°.

The reinforced edges, when provided, can be used for attac ment to the hose of clamping plates for use in dragging the inflated bolster forward or, in the case of a floating boom, for supporting weight, anchor plates or the like.

Figs.5-7 show the production of a hose 20 having a divided internal passageway. In this case the innermost ply 31 is folde as shown in Fig.5 with adhesion preventing material positioned as indicated at 32. In the finished hose the portion 33 of the innermost ply constitutes an internal bulkhead.

When the hose is to be used as a pillow tank or bolster its closed ends can be formed in a number of ways. Thus the ends of the hose can be flattened after trimming and clamped by bolts 34 between metal brackets, as shown in Fig.8, or drilled and rivete with washers. As an alternative to the use of metal and as show in Figs.9 and 10, the anti-adhesion material may be omitted at t

ends of the hose so that all the plies become vulcanized together at the ends. In this case it may be desirable to turn the fabric plies alternately over the end (Fig.10), or to provide additional reinforcing plies 29 (Fig.9) of rubberized fabric round the ends of the carcase and use an end moulding bar in the press.

Reference has already been made to the use of a former and a suitable former 34 is shown in Fig.11. The former has rounded edges 35 which ensure that no sharp creases will be formed at the edges of the tube 20 constituting the innermost ply (Fig.12).

Figs.13A, B and C illustrate the formation of a rubber former having embedded textile yarns. As shown, the yarns 36 are laid on a sheet 37 of rubber, which is afterwards folded around the yarns and vulcanized.

Sharp creases at the edges of the innermost ply may also be avoided, as shown in Fig.14, by including in the structure to be cured longitudinal rods 38 of vulcanized or semi-vulcanized rubber. The press includes concave edge moulding bars 26.

Sharp creases can also be avoided by incorporating in the interior of the carcase a semi-cured inner tube made up and tested before it is incorporated into the structure. The use of a semi-cured inner tube prevents the production of sharp creases at the edges of the innermost ply during vulcanization because the semi-cured layer of rubber does not flow to any appreciable extent. The degree of semi-vulcanization will be such that as much as possible of its resistance to the formation of flow creases is obtained, whilst it is still possible to obtain a good bond at the overlap joint, and to the textile ply to which it is adhered. The choice of exact degree of semi-cure for the optimum balance between these conflicting requirements will depend on the nature of the individual rubber composition in question.

Sharp creases can also be avoided, as shown in Fig.15, by using an unvulcanized flattened rubber tube 39 as the innermost

ply and incorporating longitudinally extending fabric strips 40 within the edges of this tube. By the use of fabric having good strength and elongation properties (e.g. staple nylon fabric) we can ensure that the fabric strips, which become bonded to the rubber tube, act as formers to give a finite radius of curvature at the edges and prevent subsequent cracking.

Reference has been made above to the use of plies of woven fabric wrapped with staggered longitudinal joints. As an alternative the plies may consist of the material known as tyre cord, i.e. a rubberized fabric having substantial warps and light wefts which suffice only to hold the fabric together. When such fabric is used to make the inflatable structure it is lapped helically in strip form around a preformed inner tube of rubber or the like, or around a suitable flat former, in pairs of opposing layers in which the warps extend helically in opposite directions and incline to the axis of the structure at approximately the ideal angle of $54^{\circ}\ 45'$.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of manufacturing an inflatable structure which is impervious to fluids and is built up of superposed plies of rubberized fabric or other material which will cure and bond to an adjacent ply under heat and pressure, which method comprises curing under heat and pressure in a conveyor or similar press successive lengths of an assembly constituted by the superposed plies, which are wrapped around one another with staggered joints, the assembly including between the opposed surfaces of the innermost ply a material which will prevent said opposed surfaces from bonding together.

2. A method as claimed in claim 1, in which the innermost ply is a tube of rubber, polyvinyl chloride or other suitable thermoplastic material having no fabric reinforcement and the adhesion-preventing material is provided as a coating on the interior of this tube.

3. A method as claimed in claim 1 or 2, in which the assembly includes an abrasion resisting cover.

4. A method as claimed in claim 1, in which the adhesion-preventing material is constituted by a withdrawable former disposed within the assembly.

5. A method as claimed in claim 4, in which a parting agent is provided between the former and the innermost ply.

6. A method as claimed in claim 4 or 5, in which the former is a strip of metal with rounded edges.

7. A method as claimed in claim 4, in which the former is a strip of vulcanized rubber.

8. A method as claimed in claim 7, in which the former contains embedded textile yarns.

9. A method as claimed in claim 1, in which the press includes edge moulding bars.

10. A method as claimed in claim 9, in which the edge moulding bars have concave inner faces.

11. A method as claimed in claim 9 or 10, in which the press includes top and bottom edge moulding bars for forming ribs at the edges of the inflatable structure.

12. A method as claimed in claim 1 or 2, in which the innermost ply is so shaped that the structure has an internal transverse bulkhead.

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INFLATABLE BOLSTER

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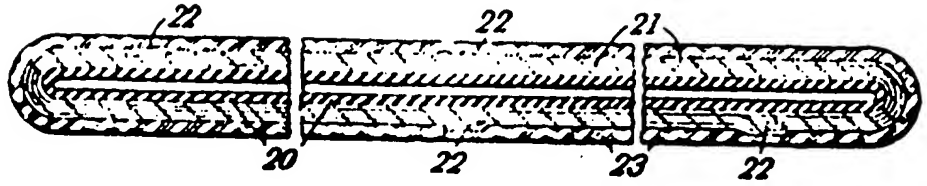

Fig. 1.

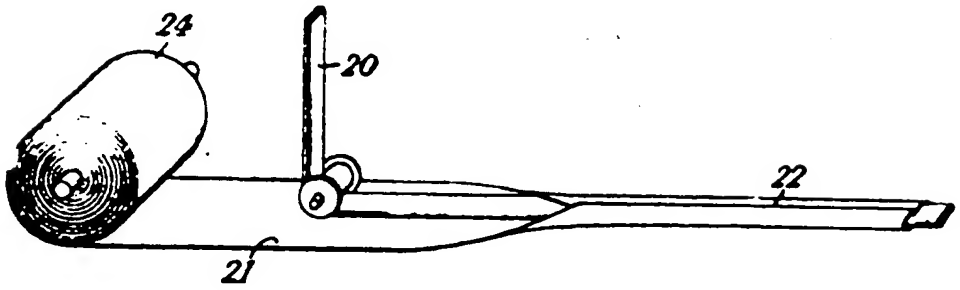

Fig. 2.

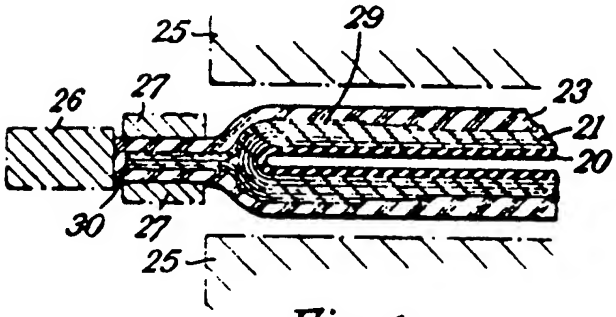

Fig. 4.

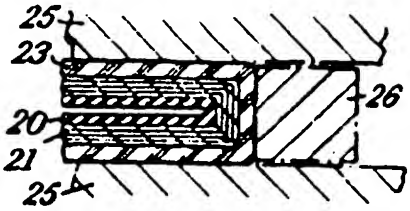

Fig. 3.

Fig. 5.

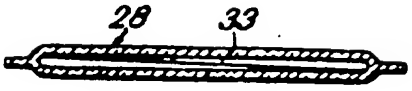

Fig. 6.

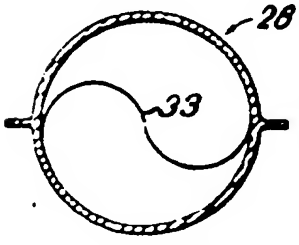

Fig. 7.

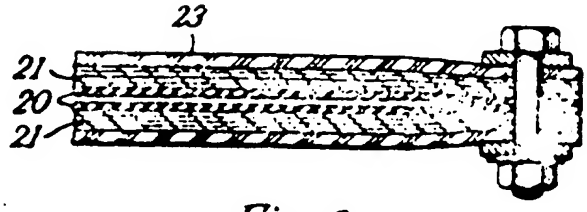

Fig. 8.

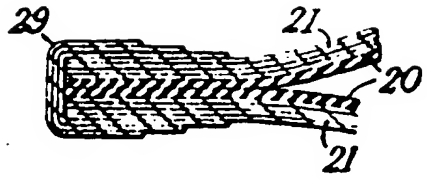

Fig. 9.

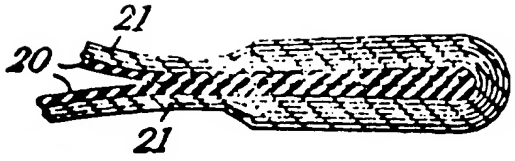

Fig. 10.

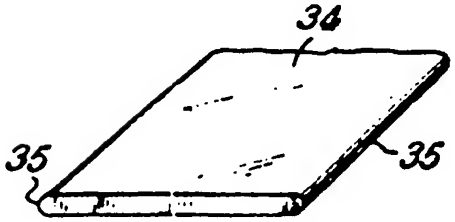

Fig. 11.

Fig. 13A.

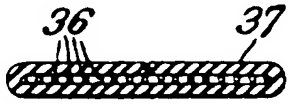

Fig. 13B.

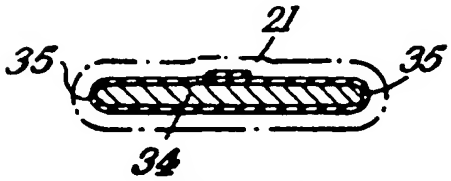

Fig. 12.

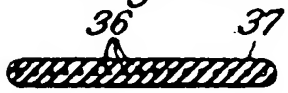

Fig. 13C.

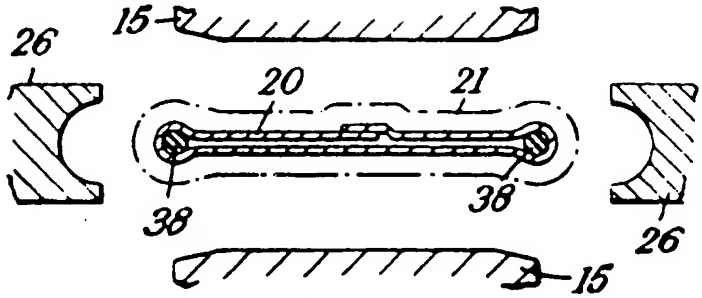

Fig. 14.

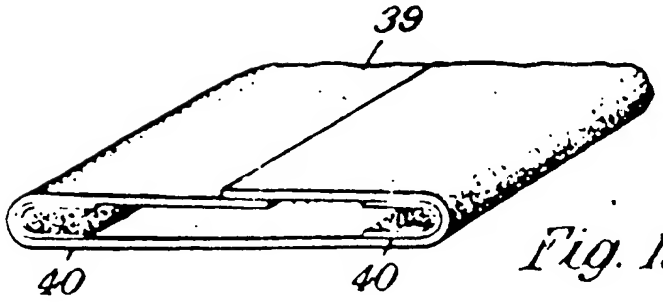

Fig. 15.